

## EFFECTIVENESS OF NURSERY PLANTING DATES OF *ATRIPLEX HALIMUS* AND *SALSOLA VERMICULATA* ON DECREASING SEEDLINGS PRODUCTION COST IN JORDAN

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### ABSTRACT

Seeds of *Atriplex halimus* and *Salsola vermiculata* were planted in nursery in March. Their stems were woody and their roots were convoluted, hence, stems and roots were pruned. The study aimed to determine the suitable planting date and decrease their production cost. Seeds were planted in 2 nurseries during 4 planting dates using the complete randomized design (CRD). Planting dates were, March, August, September and October. Seedlings production cost was calculated for March, August and September planting dates. *Atriplex* seeds showed capability to germinate during August and September, while *Salsola* didn't germinate well during August and September. The germination percentage of *S. vermiculata* seeds was 95 %, 40 %, 5 % and 0 % in March, August, September and October planting dates, respectively. While, the germination percentage of *A. halimus* seeds was 90 %, 84 %, 77 % and 70 % for March, August, September and October planting dates, respectively. *A. halimus* is recommending for the latest planting dates on August and September, whereas *S. vermiculata* recommended for the early planting date on March. For *A. halimus*, August and September planting were reduced seedlings production cost by 33 % and 38 %, respectively.

**KEYWORDS:** Fodder Shrubs, Forestry, Nurseries, Planting Dates, Rangeland, and Seedlings Cost

### INTRODUCTION

Fodder shrubs are widely planted in order to restore and rehabilitate Jordanian rangeland (Al-Satari, *et al.* 2012). *Atriplex halimus* and *Salsola vermiculata* are the main planted shrubs in the rangeland because of their drought tolerance, palatability to sheep and goats and their highly nutritive value. Hyder and Akil (1987) noted that *A. halimus* L, *A. nummularia* and *A. canescens* are the main planted fodder shrubs in deteriorated rangeland of Jordan. *Atriplex* shrubs are considered as most important forage plant in the Jordanian rangeland. Makhadmeh (1990) reported that *Atriplex* shrubs can tolerate drought and salinity in addition to their high forage productivity and nutritive value. *S. vermiculata* planted in Badia benchmark project (Al-Satari and Muddaber, 2008), and Rangeland rehabilitation project at Sabha region (Al-Satari, *et al.* 2009) for rangeland rehabilitation in Jordan.

Seeds of *A. halimus* and *S. vermiculata* are planted in nurseries in Jordan during March. Shrubs of 9 – 10 month age are planted in the permanent location during December until January. Stem wooding and root coiling were happened on the planted seedlings in nursery. Therefore, *Atriplex* seedling shoot and root pruning were needed. This is would lead to extra cost and bad quality shrubs after planting in the deteriorated rangeland (Forestry Directorate, personal communication). Al-Zoubi and abd Alsameea (1997) showed that cost of single seedling of fodder shrubs or forestry was 0.076 JD including labor, planting plastic sack, soil mixture, irrigation water, seeds, land rent, nursery staff and tools,.

Also, Fsheikat (1999) showed that cost of single seedling of *Acacia*, *Atriplex* and *Prosopis* species were 0.073, 0.076 and 0.073 JD in Waleh, Khaldiah and Deir Alla nurseries respectively.

Specific references of *A. halimus* and *S. vermiculata* planting dates are limited. *A. halimus* seeds planted on March were recommended and further studies are needed to evaluate other planting dates during summer and autumn in nursery (Al-Satari *et al*, 2013). The planting date in March was considered as a local check (Forestry Directorate, personal communication). The objectives of this study were to determine the suitable planting date of *A. halimus* and *S. vermiculata* and decrease their seedlings production cost.

## METHODOLOGY

The present study included 2 parts; planting dates and seedlings cost study.

### The Planting Dates Study

The study was conducted at 2 locations in Khaldiah and Waleh nurseries. Khaldiah nursery is 60 km West of Amman and 580 m altitude above the sea level. While, Waleh nursery is 30 km South of Amman and 457 m altitude above the sea level. The 2 nurseries are producing forestry and fodder seedlings under irrigation. Three planting dates of *A. halimus* and *S. vermiculata* seeds were planted during 15 of August, 15 of September and 15 of October 2009.

One hundred plastic bags for each plant kind were planted. The planting media was soil, sand and manure (3:1:1). Separated experiment was held for each plant kind. Germination percent was recorded in December 2010. Plant height (PH), longest (D1) and smallest (D2) plant diameter were measured, fresh weight (Fwt., weight of plant growth over ground), browse weight (Bwt., weight of leaves and branches less than 5 mm diameter), wood weight (Wwt., weight of fresh weight – browse weight), and dry weight (Dwt., weight of browse weight were dried in an oven at 72 °C for 72 hours) of *A. halimus* were recorded.

### The Seedlings Cost Study

Two thousand of *A. halimus* seedlings cost was calculated for all planting processes including land rent, seeds, plastic sacks, soil mixture, protection, buildings and mulch which were considered as fixed costs. While, irrigation water, electricity, water pump, transfers, fuel, and staff were considered as variable costs. Then cost of seedlings was calculated/ha. The study includes three planting dates on March, August and September 2010.

### Experimental Design and Statistical Analysis

The experimental units were allocated randomly through a complete randomized design (CRD) and 5 replicate were used. A general linear model (GLM) procedure (SAS, 2001) was used for analyzing the data. Treatment average were compared using Duncan test (Duncan, 1955). The independent variables included in the model were planting dates.

While, the dependent variables were the PH, D1, D2, Fwt., Bwt., Wwt., Dwt. and seedlings cost including irrigation water, electricity, water pump, transfers, fuel, staff, labor and mulch.

## RESULTS

The germination percent of *S. vermiculata* seeds showed high significant differences ( $P < 0.0001$ ) between the different planting dates. Germination percentage was 95 %, 40 %, 5 % and 0 % in March, August, September and October planting dates, respectively. While, the germination percent of *A. halimus* seeds showed high significant differences ( $P = 0.0055$ ) between the planting dates. Germination percents were 90 %, 84 %, 77 % and 70 % in March, August,

September and October planting dates, respectively. Also, *Atriplex* shrubs which were planted in March showed highly significance differences in plant height, longest and smallest plant diameter, fresh weight, browse weight, wood weight and dry weight ( $P<0.05$ ). In addition, August and September planting dates showed highly significant differences same as March for the smallest plant diameter, fresh weight, browse weight, wood weight and dry weight "Table 1".

The study cost included only *Atriplex*, and wasn't included *Salsola* because of very low germination percentage of *Salsola* seedlings in August, September and October. Also, for *Atriplex* the study includes August and September because of low germination percentage in October and seedlings small size easy to lost through handling to permanent site.

The total fixed cost was 112.39 US\$; Table (2) shows land rent, seeds, plastic sacks, soil mixture, protection, buildings and mulch cost for 2000 seedlings in Khaldiah nursery. Seed price was 21 US\$/kg which content 100000 seed/kg (Official Newsletter. 1993) and 5 seeds were planted in every sack. Plastic sacks price was 2100 US\$/ton and the sack weight was 10.5 g. Soil mixture price was 0.0064 US\$/sack, (3 soil: 1 organic fertilizer: 1 sand, which needs 6 m<sup>3</sup> soil \* 5.6 US\$/m<sup>3</sup>, 2 m<sup>3</sup> organic fertilizer \* 7 US\$/m<sup>3</sup> and 2 m<sup>3</sup> sand \* 8.4 US\$/m<sup>3</sup> to produce 10000 sack). Protection price was 5.95 US\$/m and 350 US\$/Gate.

For the variable costs, no significance differences had been noted between the planting date in most of cost components. High significance differences ( $P<0.05$ ) was noted in irrigation water (1.4 US\$/1 m<sup>3</sup>), seedling cost and cost/ha. March planting date showed the highest cost while, August and September showed the lowest cost "Table 3".

The seedling cost was 0.357, 0.238 and 0.238 US\$ for March, August and September planting date, respectively.

There are moderate positive correlation between planting dates and plant height ( $r=0.70, P<0.0001$ ), and between D1 and D2 ( $r=0.89, P<0.0001$ ), while, there are strong positive correlation between fresh weight and browse weight ( $r=0.99, P<0.0001$ ), fresh weight and wood weight ( $r=0.96, P<0.0001$ ), fresh weight and dry weight ( $r=0.99, P<0.0001$ ), browse weight and wood weight ( $r=0.92, P<0.0001$ ), browse weight and dry weight ( $r=0.99, P<0.0001$ ), and wood weight and dry weight ( $r=0.92, P<0.0001$ ).

**Table 1: *Atriplex* Shrubs Measurements Means of Plant Height (PH), Longest (D1) and Smallest (D2) Plant Diameter, Fresh Weight (Fwt), Browse Weight (BY), Wood Weight (Wwt.) and Dry Weight (Dwt.) on Four Planting Dates During 2009 Season**

Planting Date	PH (cm)	D1 (cm)	D2 (cm)	Fwt. (g)	Bwt. (g)	Wwt. (g)	Dwt. (g)
15 <sup>th</sup> March	63.85 a	15.90 a	9.4 a	105.4 a	74.45 a	30.95 a	23.13 a
15 <sup>th</sup> August	40.50 b	9.10 b	6.3 ab	64.4 ab	44.75 ab	19.65 ab	14.06 ab
15 <sup>th</sup> September	34.60 b	10.05 b	7.8 ab	60.6 ab	44.60 ab	16.00 ab	13.38 ab
15 <sup>th</sup> October	28.90 b	7.60 b	5.3 b	16.7 b	12.20 b	4.55 b	3.93 b

Means with the same letter at the same column are not significantly different.

**Table 2: The Fixed Cost; Land Rent, Seeds, Plastic Sacks, Soil Mixture, Protection, Buildings and Mulch of 2000 Seedlings Planted in Khaldiah Nursery**

Item	Cost (US\$)
Land rent	1.75
Seeds	2.8
Plastic sacks	44.1
Soil mixture	12.8
Protection	45.08
Buildings	1.53
Mulch	4.33
<b>Total</b>	<b>112.39</b>

**Table 3: Water, Seedling and Hectare Cost (US\$) at Khaldiah and Waleh Nurseries in 2010**

Variable	Planting Date		
	March	August	September
Water	180.6 a	98.0 b	86.8 b
Seedling Cost	0.357 a	0.238 ab	0.221 b
Cost per Hectare	341796 a	228354 ab	212380 b

Means with the same letter in the same row are not significantly different.

## DISCUSSIONS

The germination percent of *S. vermiculata* seeds was very low in August, September and October. This is because of unsuitable environmental conditions that satisfy germination requirements of *Salsola* seeds in August, September and October. While, the high germination percent of *A. halimus* seeds indicated suitable environmental conditions that satisfy germination requirements in latest planting dates. Despite the decrease in plant height, longest and smallest plant diameter, fresh weight, browse weight, wood weight and dry weight, however, germination percentage was still high for *A. halimus*. Therefore, August and September planting dates were recommended for *Atriplex* species. The latest planting dates in August and September were spent less time in the nursery (5 and 4 months, respectively) in comparison with the earlier date in March (10 months); we could predict that this will decrease the cost of *Atriplex* species seedlings production.

The seedling cost was decreased from 0.357 US\$ for March planting to 0.238 and 0.221 US\$ for August and September planting date, respectively. In comparison to March planting date, the seedlings production cost was decreased by 33 % and 38 % for August and September planting dates, respectively.

*Atriplex* seedlings were suffered from stem wooding and root coiling in nursery and they were pruned before transferred to the permanent site. Present study was overcome the problem. August and September seedlings were more juvenile, less wood content and less root growth in comparison with those of March. Those results solved the problem of stem wooding and root coiling of the planting shrubs during March, in addition, shoot and root pruning weren't needed.

## RECOMMENDATIONS

Finally, *S. vermiculata* seeds planting is recommended in March while, August and September planting are recommended for *A. halimus* seeds in nursery. It had good germination percentage and reduce seedlings production costs. Further studies are needed to study the *Atriplex* roots for different nursery planting dates, and shrubs survival percentage after planting the seedlings in the permanent rangeland site.

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